SECTION 13: SCREENING FOR PRE-DIABETES AND DIABETES

Concern	Care/Test	Frequency
Screening for Pre-diabetes and Diabetes	♦ Perform fasting plasma glucose test or oral glucose tolerance test (**see Algorithm 6**)	Test all people ≥ age 45; if normal and person has no risk factors, retest in 3 years

Pre-diabetes

Pre-diabetes is a condition where blood glucose levels are higher than normal, but not high enough to be diagnosed as diabetes. Individuals with pre-diabetes have impaired fasting glucose (100-125 mg/dL), and/or impaired glucose tolerance (2-hour blood glucose between 140-199 mg/dL). The term pre-diabetes was introduced in 2002 to more accurately identify the large number of people who fall into this category and are at risk of developing Type 2 diabetes. Unless lifestyle modifications are made to help return elevated blood glucose levels to the normal range, most people with pre-diabetes develop Type 2 diabetes within ten years. Pre-diabetes is also associated with insulin resistance and metabolic syndrome.

Insulin Resistance

Insulin resistance is an impaired biological response to insulin and is often an underlying factor in pre-diabetes and Type 2 diabetes. Many individuals have a genetic predisposition to insulin resistance. Decreased insulin sensitivity interferes with the following activities: 1) removal of glucose from plasma, 2) glucose utilization in muscle and fat tissue, and 3) suppression of glucose production in the liver. Virtually all people with Type 2 diabetes have some degree of insulin resistance. People with pre-diabetes may even have insulin resistance and a normal glucose test. This is because the pancreas compensates for insulin resistance by producing more insulin (resulting in hyperinsulinemia) in order to maintain normal blood sugar levels. Conditions associated with the development of insulin resistance and subsequent pre-diabetes and Type 2 diabetes include overweight and obesity, advancing age, and abdominal obesity independent of body weight. Insulin resistance and the resulting hyperinsulinemia are associated with hypertension, hypertriglyceridemia, decreased HDL-cholesterol, and increased risk of atherosclerosis and cardiovascular disease.

Metabolic Syndrome

Metabolic syndrome represents a constellation of lipid and non-lipid risk factors of metabolic origin. In the past, this syndrome has been called Syndrome X, Insulin Resistance, Dysmetabolic Syndrome, and Cardiac Dysmetabolic Syndrome. Although metabolic syndrome and pre-diabetes may be present at the same time, not all people with metabolic syndrome have pre-diabetes and not all people with pre-diabetes have metabolic syndrome. It is estimated that approximately 40% of people with impaired glucose tolerance (IGT) and 70% of people with Type 2 diabetes also have metabolic syndrome. Metabolic syndrome is diagnosed when three or more of the following risk factors are present:

- Abdominal obesity (assessed by waist circumference): men > 40 inches, women > 35 inches
- Triglycerides ≥ 150 mg/dL
- HDL-cholesterol: men < 40 mg/dL, women < 50 mg/dL
- Blood pressure ≥ 130/85 mmHg
- Fasting glucose ≥ 100 mg/dL

Polycystic Ovary Syndrome

Insulin resistance is possibly an underlying cause of polycystic ovary syndrome (PCOS), an endocrine (hormonal) disorder affecting 5-10% of all women. For some women, symptoms first appear during the teen years, while others do not develop symptoms until they are in their twenties. PCOS may continue through menopause. Diagnosis is made with a combination of a physical exam, blood tests, and the presence of several symptoms, including hirsutism (excessive hair growth), acne, obesity, infertility, and irregular menstrual periods. The exact cause of PCOS is unknown at this time, and there is currently no cure. The current approach is to treat individual symptoms and focus on insulin resistance.

Cardiovascular Risk with Pre-diabetes

According to the Framingham Heart Study, people with diabetes are at the same risk of a cardiac event as people who have a diagnosis of chronic heart disease (CHD). However, the National Cholesterol Education Program Adult Treatment Panel (ATP) III does not consider pre-diabetes a CHD risk-equivalent. The ATP III identifies pre-diabetes as one component of metabolic syndrome, signifying the need for intensive lifestyle change and careful screening of all other cardiovascular risk factors (see Section 5: Cardiovascular Care).

Opportunistic Versus Community Screening

Opportunistic screening is conducted by health care providers or health systems (e.g., health maintenance organizations or hospital/clinics) for selected people or groups of people. Community screening is defined by the American Diabetes Association (ADA) as "taking place outside a health care setting." Opportunistic screening is recommended by the ADA and the Centers for Disease Control and Prevention (CDC), while community screening is not. Since many health care systems are providing community screening at health fairs and other community sites, it is important to emphasize that individuals identified as being at risk for diabetes through community screening, either through a risk questionnaire or from a capillary blood glucose test result, must receive referral to a health care provider who can provide appropriate comprehensive diabetes screening and follow-up.

A fasting plasma glucose (FPG) test and and oral glucose tolerance test (OGTT) can be used to detect pre-diabetes and diabetes. Both of these tests are useful in terms of their ability to detect hyperglycemia and diagnose diabetes, but they are not exactly interchangeable. The FPG test does not always detect impaired glucose tolerance (IGT) and the 2-hour plasma glucose value in the OGTT does not always detect impaired fasting glucose (IFG). A "random" or "casual blood test" with results $\geq$ 200 mg/dL is also be used to diagnosis diabetes. Although this test is the most convenient, it is not nearly as reliable or effective as the FPG and OGGT tests. A1c measurements are good for indicating overall control, but not recommended for diagnosing diabetes.

If a person undergoes a FPG test and the first glucose is $\geq$ 126 mg/dL, but the second is between 100 and 125 mg/dL, the person has impaired fasting glucose (see Table 19). If the person has an initial FPG between 100 and 125 mg/dL and the second FPG is normal, the person has pre-diabetes not otherwise specified (see Table 19). In either case, it may be prudent to consider re-testing with a 2-hour OGTT, especially if the person has more than one risk factor for diabetes. The 1-hour and 5-hour OGTT are no longer recommended for use in routine clinical practice.

The 3-hour 100 gram OGTT is used only during pregnancy. The FPG test is the preferred method of detection for the following reasons:

1) It is less expensive
2) It is more easily reproduced for verification
3) It is better accepted
4) It is fast and convenient

The OGTT may be a more appropriate test in selected groups of people, especially in the postpartum period for women who have a history of gestational diabetes. The OGTT also appears to be more sensitive than the FPG in detection for the elderly and some ethnic groups. Table 20 provides International Classification of Diseases-9 (ICD-9) codes for various glucose abnormalities.

Table 19: Diagnosis of Pre-diabetes and Diabetes (2004 Criteria)

Test	Fasting Plasma Glucose (FPG)	Oral Glucose Tolerance Test (OGTT)	Random/Casual Plasma Glucose (with symptoms)
How Performed	Blood glucose is measured after at least an 8 hour fast	75-gram glucose load (drink) is ingested after at least an 8 hour fast; blood glucose is measured at 2 hours	Blood glucose is measured at any time regardless of eating
Normal	< 100 mg/dL	< 140 mg/dL	
Pre-diabetes (IFG)	100 – 125 mg/dL		
Pre-diabetes (IGT)		140 – 199 mg/dL	
Diabetes Mellitus	≥ 126 mg/dL ❖	≥ 200 mg/dL	≥ 200 mg/dL ❖⌘ (with symptoms)

IFG: Impaired fasting glucose
IGT: Impaired glucose tolerance
❖ Test must be confirmed by repeating on a different day
⌘ It is not appropriate to have a person eat a meal and then draw a random glucose two hours after

Table 20: Diabetes-related International Classification of Diseases-9 (ICD-9) Codes

Condition	ICD-9 Code
Abnormal glucose	790.2
Impaired fasting glucose *Elevated fasting glucose*	790.21
Impaired glucose tolerance test (oral) *Elevated glucose tolerance test*	790.22
Other abnormal glucose *Abnormal glucose NOS* *Abnormal non-fasting glucose* *Pre-diabetes NOS*	790.29
Metabolic Syndrome	277.70
Polycystic Ovarian Syndrome (PCOS)	256.40

NOS = Not otherwise specified

Management of Pre-diabetes and Metabolic Syndrome

Lifestyle changes, including weight management, diet modifications, and regular physical activity, are critical to the management of pre-diabetes. Studies demonstrate that modest weight loss, when combined with regular physical activity, has the potential to normalize blood glucose levels. Maintaining lifestyle changes can be difficult for many people. Research demonstrates that structured programs involving health professionals are the most effective for supporting and maintaining change. People who used self-monitoring (daily or weekly weigh-ins, food or physical activity records, etc.) were most likely to maintain weight loss. Medical nutrition therapy (MNT) can be extremely beneficial in assisting people with weight loss and healthy eating. It is recommended that each person check with their insurance carrier to see if MNT is a covered benefit for pre-diabetes.

Some studies provide evidence that pharmacological agents may be beneficial for preventing the onset of diabetes. However, cost-effectiveness and overall effectiveness still need to be measured to substantiate those studies. At this time, the ADA discourages the routine use of drug therapy for the following reasons:

1) Evidence shows that oral agents are less beneficial than lifestyle modifications. Weight loss and increased physical activity remain the gold standard and should be the first choice of treatment.
2) Metformin was less efficacious overall while lifestyle modifications were more efficacious in older and relatively leaner people. Acarbose performed similarly to Metformin, but its study participants were very different.
3) All glucose-lowering drugs have side effects and, for some people, they are contraindicated.

Essential Patient Education for Pre-diabetes

All people at risk, regardless of what risk factor or category, should be aware of, and understand, the opportunities they have to prevent disease and reduce risk for Type 2 diabetes. Educational strategies should take into consideration special educational and cultural needs and literacy level/skill, while respecting the individual willingness to change behavior. Education may include, but is not limited to, the following:

- Discuss and explain opportunities to reduce risk of developing Type 2 diabetes and improving overall health.
- Assess readiness for personal change, identify interventions, set realistic goals.
- Communicate basic information about pre-diabetes, insulin resistance, metabolic syndrome, and polycystic ovary syndrome (PCOS).
- Offer support in identifying barriers to implementing lifestyle changes.
- Assist with the review and revision of personal lifestyle change goals.
- Refer to community resources (e.g., free educational classes and support groups for healthy lifestyle changes related to nutrition, MNT, telephone support/counseling, and on-line resources).
- Assess motivation and urge slow, gradual changes (these are incorporated more easily and with less resistance).
- Check with insurance carrier to see if MNT is a covered benefit for pre-diabetes.

Helpful Tools Included in this Section

- Algorithm 6: Screening for Pre-diabetes and Diabetes
- Medical Nutrition Therapy for Pre-diabetes and Metabolic Syndrome

Additional Resources

1) Small Steps, Big Rewards. Prevent Type 2 Diabetes. National Diabetes Education Program (NDEP) Campaign. Information and materials available. Web site located at: http://www.ndep.nih.gov/campaigns/SmallSteps/SmallSteps_index.htm.
2) Assessment and Management of Adult Obesity: A Primer for Physicians. Case Studies in Disease Prevention and Health Promotion. Consists of ten booklets that offer practical recommendations for addressing adult obesity in the primary care setting. Web site located at: http://www.ama-assn.org/ama/pub/category/10931.html.
3) Transtheoretical Model: Stages of Change. Web site located at: www.uri.edu/research/cprc/TTM/detailedoverview.htm.
4) Diabetes Prevention Program Lifestyle Materials. Web site located at: http://www.bsc.gwu.edu/dpp/lifestyle/dpp_dcor.html.

Screening for Pre-diabetes and Diabetes – Question and Answer

Q: Why is it important to identify people "at risk" for developing pre-diabetes?

A: The prevalence of diabetes is increasing. As the high number of "baby boomers" age, the percentage of people ≥ 45 years will increase. Evidence from well-known studies such as the Diabetes Prevention Program (DPP) have shown supportive education for medical nutritional therapy (MNT) and self-management after the diagnosis of pre-diabetes are effective in slowing and even preventing the progression to Type 2 diabetes.

Q: How can Type 2 diabetes be prevented?

A: People at risk of developing pre-diabetes and/or diabetes can make lifestyle changes to prevent or delay the progression of the disease. There is substantial evidence that interventions, specifically both modest weight loss (5-10%) and increased physical activity, will help prevent the progression of pre-diabetes to Type 2 diabetes. The Diabetes Prevention Program (DPP) studied the effects of lifestyle changes (healthy eating and a physical activity program) and the drug Metformin. The lifestyle modification group received intensive education and support on nutrition and physical activity without Metformin, while the Metformin group received standard information on physical activity and diet as well as medication. A third group (placebo group) received only standard information on physical activity and diet. Results showed that people in the lifestyle modification group reduced their risk of developing Type 2 diabetes by 58%. The average weight loss in the first year of the study was 15 pounds. Lifestyle modification was even more effective in those 60 years and older, reducing risk by 71%. People receiving Metformin reduced their risk by only 31%, compared to the placebo group. Metformin was most effective in younger, more obese people.

Q: Is there a difference between screening for diabetes and diagnosing diabetes?

A: Yes, the American Diabetes Association's position statement entitled "Screening for Type 2 Diabetes" defines the differences. "There is a major distinction between diagnostic testing and

screening. When an individual exhibits symptoms or signs of the disease, diagnostic tests are performed. The purpose of screening is to identify asymptomatic individuals (people without symptoms) who are likely to have diabetes." For many diseases, the test used to screen for the disease (e.g., mammography for breast cancer or colonoscopy for colon cancer) is different than the test used to diagnose (e.g., a biopsy). For diabetes, however, the test to screen and diagnosis is one and the same.

Q: Can you measure insulin resistance?

A: Because there is not a good, standardized insulin assay or recommendations for interpreting results, insulin assays are not routinely recommended for measuring insulin resistance. Clinical markers, such as increased waist circumference (central obesity), acanthosis nigricans (velvety hyper pigmented areas on neck and/or axillae) and biochemical markers, such as abnormal lipid levels and abnormal glucose tolerance are more reliable measures.

Q: Is an insulin level beneficial?

A: Use of insulin levels should, in general, should be restricted to research studies. Commercial insulin assays are not standardized and interpretation of the results can be difficult.

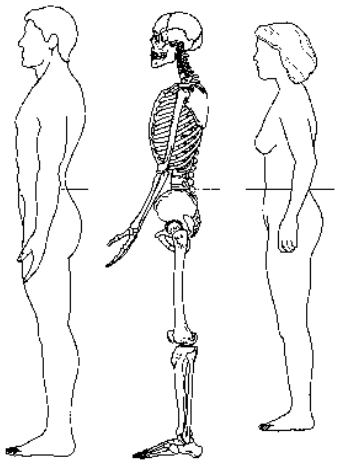
Q: How do I measure a waist circumference?

A: Measuring waist circumference provides a good assessment of abdominal or central obesity, a factor which increases the risk of developing pre-diabetes and the metabolic syndrome. Although waist circumference and body mass index (BMI) are interrelated, waist circumference provides an independent prediction of risk over and above that of BMI. Waist circumference measurement is particularly useful in people who are categorized as normal or overweight on the BMI scale. For a BMI $\geq$ 35 kg/m^2, waist circumference has little added, predictive power for disease-risk beyond that of BMI. It is therefore not necessary to measure waist circumference in individuals with a BMI $\geq$ 35 kg/m^2.

Instructions for Measuring Waist (Abdominal) Circumference

The measurement should be taken under clothing with the person standing. The tape should be placed at the iliac crest, parallel to the floor, taken after expiration. This measurement will often not follow the "natural waistline."

Measuring Tape Position



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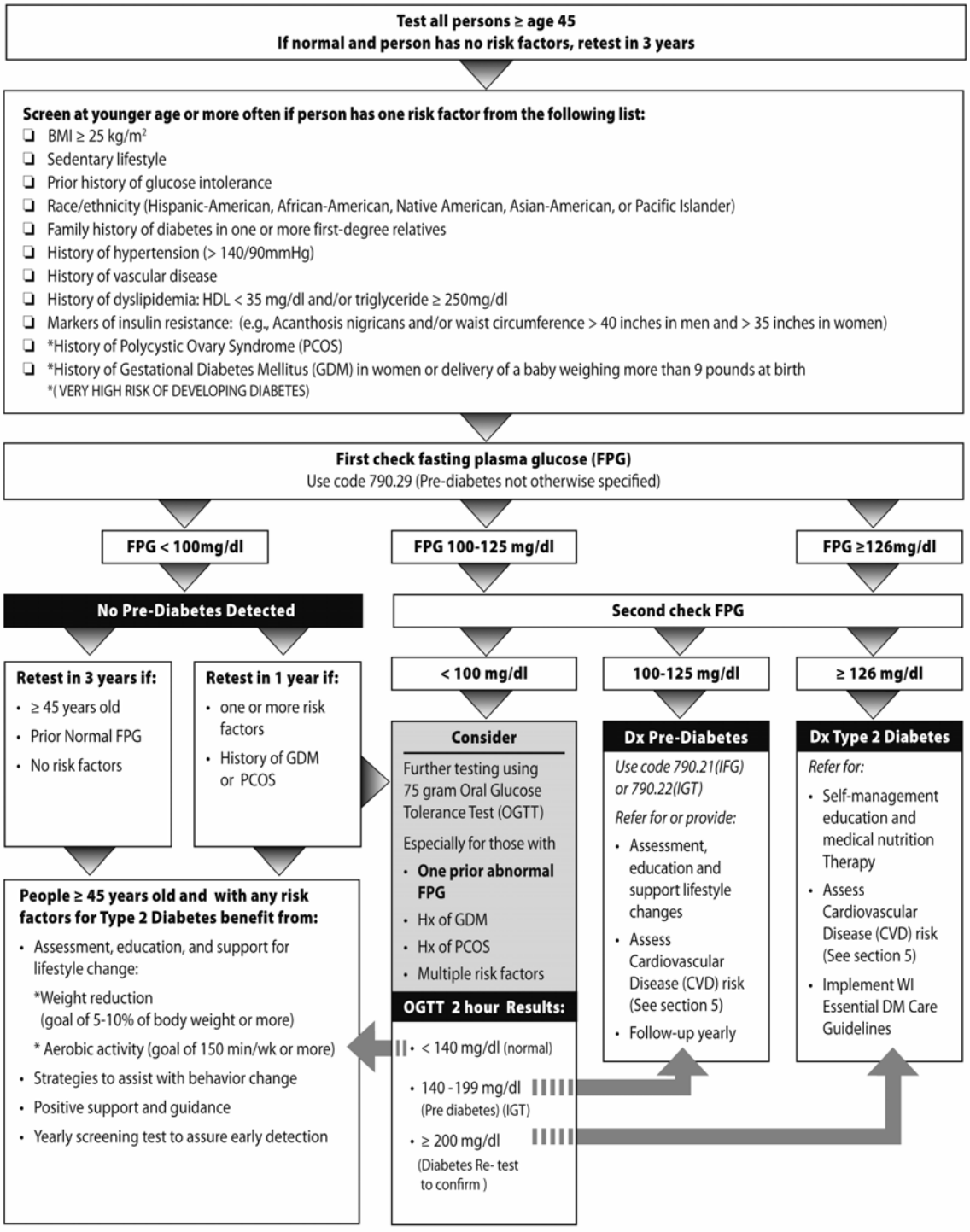
Algorithm 6

SCREENING FOR PRE-DIABETES AND DIABETES



MEDICAL NUTRITION THERAPY FOR PRE-DIABETES AND METABOLIC SYNDROME

The Medical nutrition therapy goals for pre-diabetes and metabolic syndrome involve maintaining a healthy weight and physical activity to treat the underlying causes, insulin resistance, and sedentary lifestyle.

Diet Considerations and Physical Activity for Pre-diabetes and Metabolic Syndrome

Goal	Specific Recommendations
Increase physical activity	150 minutes minimum per week
Maintain a healthy weight	At least a loss of 7% of initial body weight (if BMI ≥ 25.0 kg/m^2)
Decrease total fat and saturated fat	Total fat not greater than 25-35% of calories; saturated fat not greater than 7% of calories
Emphasize monounsaturated fat	Up to 20% of total calories
Decrease sugar and excess starch	Not greater than 50-60% calories from carbohydrates, with emphasis on whole grains, fruits, and vegetables
Decrease sodium	Not greater than 2400 mg/day
Increase fiber	Up to 25-30 g/day
Increase antioxidants	Up to nine servings of fruits and vegetables per day
Increase dietary Magnesium, Calcium, Potassium	Per 2000 calories: Mg – 500 mg Ca – 1200 mg K – 4700 mg

Healthy eating to prevent or treat pre-diabetes and metabolic syndrome includes:

- ✓ An abundance of whole grains, fruits, and vegetables.
- ✓ Legumes (dried beans, soy products, split peas, lentils), low fat dairy products, fish, and poultry as primary protein sources.
- ✓ Moderate amounts of fat from canola or olive oil and nuts.
- ✓ Reduced amounts of red meats and refined carbohydrates, especially sweets and high sugar beverages.
- ✓ Reduced sodium from processed foods.